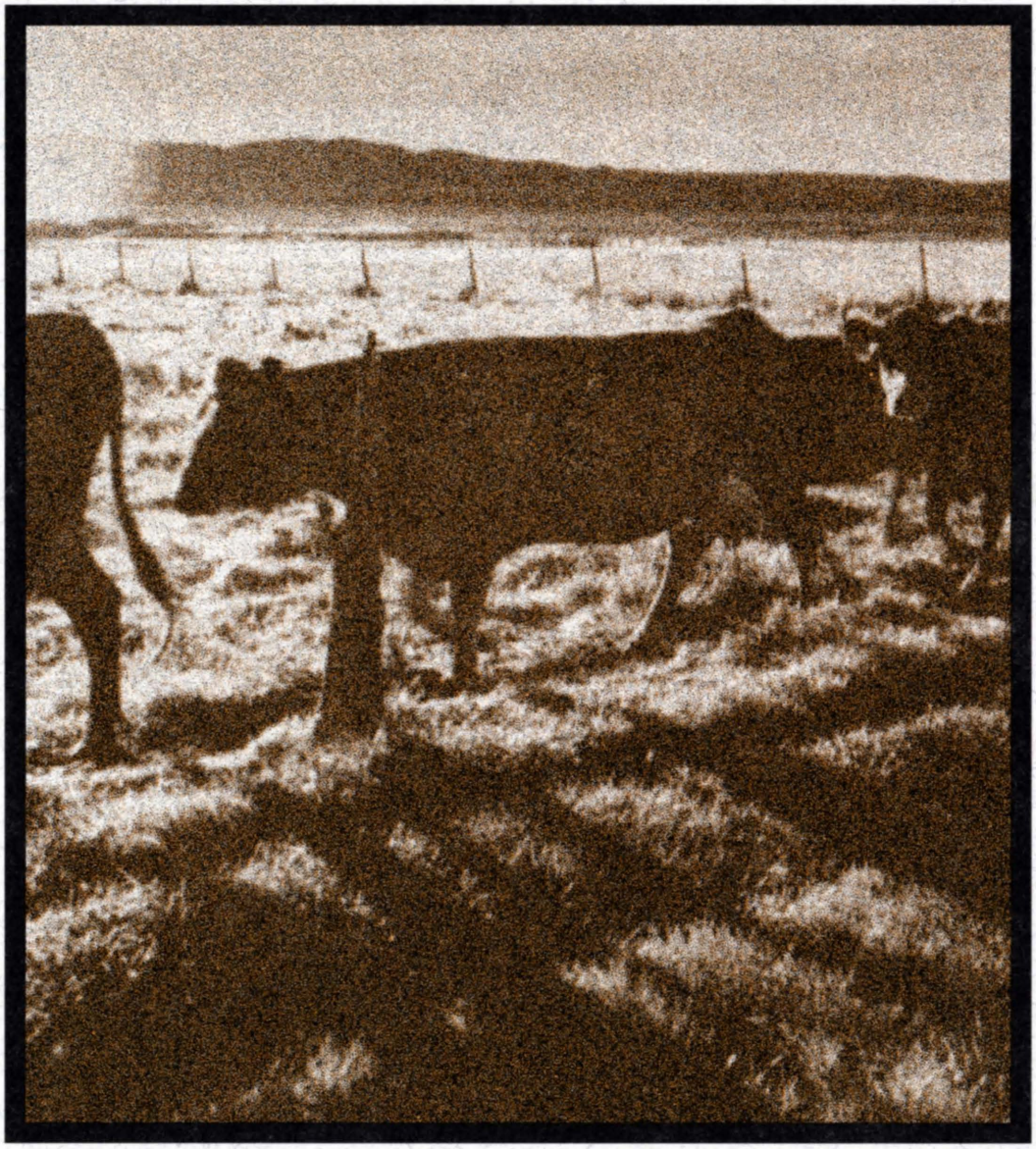
Utah Science

Volume 57 | Number 2 Article 1

Summer 1996

Utah Science Vol. 57 No. 2, Summer 1996

A Publication of the Utah Agricultural Experiment Station at Utah State University



UTAH SCIENCE

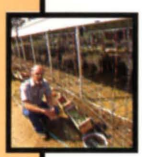
VOLUME 57 · NUMBER 2 · SUMMER 1996

UTAH SCIENCE is a quarterly publication devoted primarily to Experiment Station research in agriculture and related areas. Published by the Utah Agricultural Experiment Station, Utah State University, Logan, Utah 84322-4845.

This publication will be sent free on request in the United States, and to libraries and other public institutions elsewhere. Subscriptions mailed to individuals in other countries cost $10.00 annually. Please include a mailing label from a recent issue of *UTAH SCIENCE* with any request for change of address.

To avoid overuse of technical terms, sometimes trade names of products or equipment are used. No endorsement of specific products or firms named is intended, nor is criticism implied of those not mentioned.

CONTENTS



DEPARTMENTS

Gary Neuenswander

A Publication of the Utah Agricultural Experiment Station at Utah State University.
Volume 57 Number 2 Summer 1996

UTAH SCIENCE

CALLIPYGE:

$100 Million Butts Fit in These Genes

The recent discovery of a marker linked to a trait for bigger, leaner hindquarters in sheep is the latest in a series of events likely to lead to a major shift in livestock breeding.

Since the trait, called callipyge (an appropriately descriptive Greek word for "beautiful buttocks") was discovered in a ram in 1984, the mode of inheritance has puzzled researchers. The trait vanished and reappeared at baffling intervals, seemingly defying the conventional laws of inheritance.

Discovery of the genetic marker showed why—the gene inherited from the female is able to "turn off" the gene that her lambs receive from the male, according to Noelle Cockett, molecular geneticist at Utah State University, who recently identified the marker and characterized the inheritance of callipyge in collaboration with Michel Georges, molecular geneticist at the University of Liege, Belgium.

Unusual Method of Inheritance

Only lambs that inherit the callipyge gene from the ram and the normal gene from their mother express the trait. Lambs with any other combination of genes, including those with two copies of the callipyge gene, appear to be normal.

The potential gains in meat production from callipyge are tantalizing. Unlike double-muscling in cattle, which caused calving problems, the callipyge trait is expressed after birth and does not interfere with lambing. Callipyge increases the size of selected muscle fibers, not the number of muscle fibers.

The callipyge trait has received a mixed reaction in the sheep industry, in large part because of reduced tenderness, a problem which Cockett says has been overstated. "There's a tenderness problem only with certain cuts, usually the loin or rack. This means only a portion of a callipyge carcass requires treatment to improve tenderness.

"Moreover, the fact that tenderness isn't a problem in certain callipyge lambs indicates that the factors such as the breed of sheep and the method of finishing may influence tenderness in the callipyge carcass," Cockett adds.

"The Best Thing to Ever Happen to the Sheep Industry"

"The difference between callipyge sheep and normal sheep is the difference between me and Arnold Schwarzenegger," says Erby Chandler, a rancher in Ozona, Texas. Chandler and his partner, Steve Helbing, have been raising callipyge sheep in his 1,000-ewe (largely Ramboulet) flock for more than 10 years, ever since he took his airplane to Oklahoma and flew back with a callipyge ram in the back seat.

Gary Neuenswander

Noelle Cockett

Until Cockett explained inheritance of the trait, Chandler too was baffled by his inability to "smooth" them out. The characteristic muscling seemed to appear randomly, even when he had cross-bred sheep until their pedigrees contained barely a trace of callipyge.

Tough meat? Chandler's never run across any in callipyge lambs, and he's eaten a lot of them after they became too heavily muscled to show. ("They look like they're on steroids.") Ranchers who haven't been told they're eating lamb have said meat from callipyge lambs is "the best beef they've ever eaten," Chandler says.

Even though the muscles bulge in a newly shorn callipyge lamb, their carcasses are smooth, he says.

Chandler's fed callipyge lambs up to 180 pounds, and has plenty of data to confirm improved feed efficiency. "No matter what they're fed, after a certain point, they just keep putting on muscle, not fat. A producer can just pick the size of carcass they want and feed them to that weight without adding more than a thin line of fat."

Callipyge sheep aren't softies. "This is rough, arid country, and we've lost a lot of rams, but we've never lost a callipyge ram. You also have to be careful when putting a normal ram with a callipyge ram because that's real muscle those (callipyge) rams have put on.

"I love 'em to death. I think they're the best thing to ever happen to the sheep industry.

"I'm not in this business to promote these sheep, but I think there's just too much prejudice against them. There's a place for these sheep, but it might have to be in Australia or New Zealand where they're inventive enough to handle it (callipyge)."

A $100 Million Trait

Frank Hendrix also tried to interest the industry in the trait since 1986 after he noticed several lambs at a fair in Oklahoma with huge loin eyes. He first suspected drugs, but later attributed it to the now-famous ram that first exhibited the trait. It wasn't until 1990 that fellow researchers took note of his belief that there was a gene involved. Now he notes that some researchers who disparaged his theory are among its strongest adherents.

"The callipyge gene will be a $100 million boost to the sheep industry in the United States. Within 5 years, nearly all lambs will carry the callipyge gene," says Hendrix, Washington State University Extension livestock specialist for Yakima County. He says many producers in Washington State are just waiting for the "tenderness issue" to be resolved.

In his flock, callipyge affects only the tenderness of chops, and then in only 10 percent of the callipyge lambs.

"A callipyge lamb is worth $15 to $18.50 more to packers," Hendrix says. A loin eye area of a 6-month-old normal lamb is about 1 1/2 inches; a 2-inch loin eye is "a real muscular lamb," while the vast majority of callipyge lambs have loin eyes of 3 1/2 and 4 1/2 inches. There's 30 percent more meat in each carcass, coupled with 27 percent less fat and a 0.2 pound advantage in feed efficiency, Hendrix says.

Charles Carpenter

The difference associated with callipyge is evident in lambs (above) and in lamb chops (left).

Producers who sell on a yield basis would also capitalize on the 10 percent increase in dressing percentage.

"The meat packers I've contacted say they prefer callipyge lambs if the tenderness problem can be solved," says Sam Jackson, animal scientist at Texas Tech University.

Tenderness Problems?

In spite of rumors to the contrary, the "tenderness problem" isn't insurmountable. Consumer evaluations at Texas Tech University found no significant differences in the juiciness, tenderness, flavor, and overall acceptability of legs from callipyge and normal lambs. A combination of electrical stimulation, injection with calcium chloride, and aging for 15 days also markedly improved tenderness of callipyge chops to an acceptable level, but tenderness was still lower than chops from normal lambs, according to Charles Carpenter, meat scientist at Utah State University. Other researchers elsewhere report similar findings.

The meat packing industry has taken particular notice of consumer interest in the mammoth chops from callipyge lambs.

Superior Packing Company, Dixon, Calif., plans to start offering callipyge chops as a specialty item—after they learn the results of a cooperative research project to determine the optimum method of tenderizing callipyge chops. Among the options being considered are a device that bombards meat suspended in water with sound waves and stimulation at high voltages, in addition to other factors such as diet.

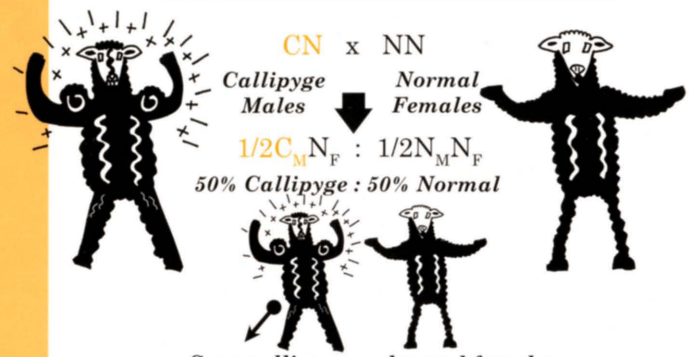
Test Allows Breeding for Callipyge

One immediate benefit of the genetic marker is the development of a blood test that lets producers devise breeding schemes so most lambs have heftier hindquarters. This requires crossing normal-appearing males with two copies of the mutation with females lacking the mutation. Previously, these animals could not be identified without extensive and expensive breeding trials.

Producing Callipyge Breeding Stock

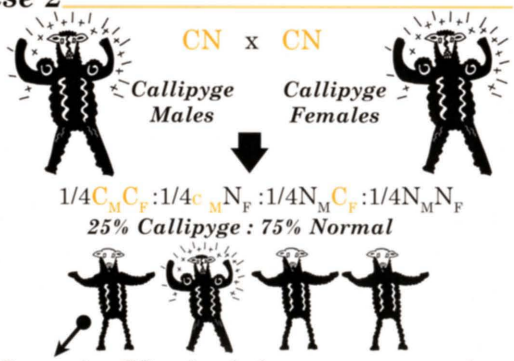
KEY	
Genotype	*Phenotype*
N_MN_F	Normal
C_MN_F	***Callipyge***
N_MC_F	Normal
C_MC_F	Normal

Phase 1



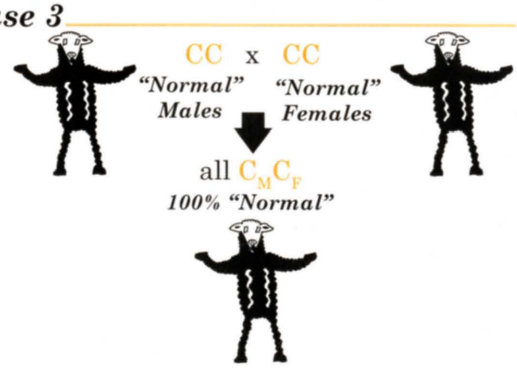
Save callipyge males and females

Phase 2

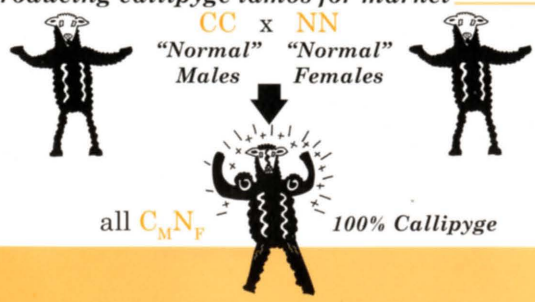


Determine CC animals from among normals

Phase 3



Producing callipyge lambs for market



To identify those lambs that carry two copies of the callipyge gene, producers must submit blood from the lambs in question, as well as blood of each parent. The cost of a test varies from $20 to $25, depending on the number of lambs involved. Only Cockett's lab currently offers the test. (Cockett must be contacted before samples are submitted in order to schedule testing dates and to clarify bleeding and shipping procedures.)

The recently identified marker will also help determine whether the callipyge gene (or genes similar to it) occurs in other species of livestock. If not present in other species, it may be possible to transfer the callipyge gene from sheep to these species.

The actual callipyge gene should be identified within a few years, Cockett says. When that happens, the livestock industry will have to seriously consider the possibility of transferring the gene to other species that lack the trait.

Rumors now seem to be the only major obstacle to the callipyge gene. Hendrix, whose experience confirms the adage about defeat being an orphan and victory having several parents, credits Cockett's contributions. "She marked it and she named it. Without Noelle's help, we couldn't have done anything with it." **KG**

MORE INFO

Charles Carpenter (801) 797-3665
chuckc@cc.usu.edu

Erby Chandler (915) 392-3107

Noelle Cockett (801) 797-3903
fanoelle@cc.usu.edu

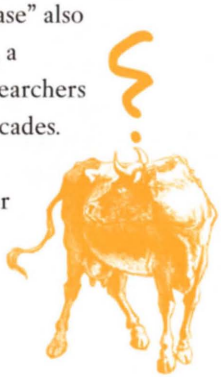
Michel Georges
michel@stat.fmv.ulg.ac.be

Frank Hendrix (509) 574-1600
hendrixf@wsu.edu

Sam Jackson (806) 742-2804

International Study Focuses on Method of Scrapie Spread

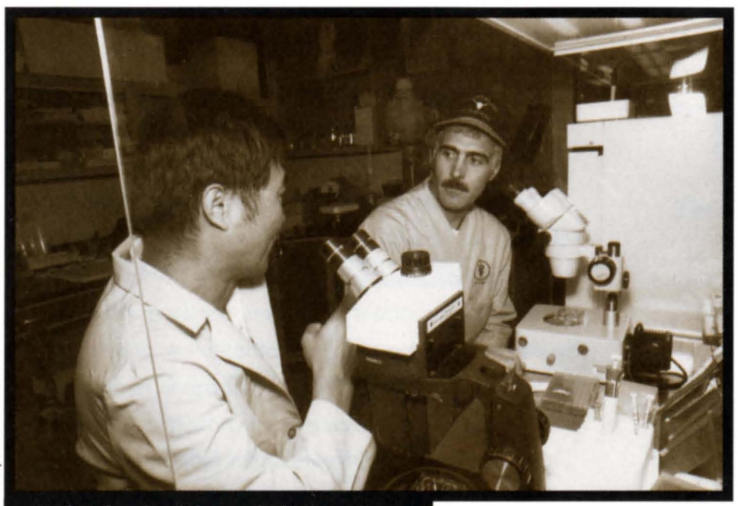
The publicity over "mad cow disease" also increased concern about scrapie, a similar disease in sheep that USU researchers have been studying for almost two decades.



The fears of spread to humans appear to be unfounded, but there's still an element of doubt.

"Scrapie has been around for at least 250 years, and epidemiological studies show no link between consumption of lamb and mutton and human neurological illnesses," says Reed Holyoak, veterinary scientist who is studying transmission of the disease among sheep. The same is true for those who herd or slaughter sheep.

Researchers question the validity of one study which linked scrapie and a neurological disease among some Lebanese.



Gary Neuenswander

Reed Holyoak (right) and Shiquan Wang.

Nonetheless, mad cow disease rocked consumer confidence in the safety of red meat and energized the search for methods to control and eliminate it and similar diseases.

Disease Agent Not Identified

Scientists have yet to determine whether the diseases are caused by a prion (a small protein), or a virus. Whatever it is, the disease agent can survive normal heat sterilization, tissue preservatives such as formalin, burying, and disinfectants. Months or years pass before an infected animal shows signs of the disease. Scrapie is one of several diseases known as transmissible spongiform encephalopathies, characterized by the moth-eaten appearance of degenerating brain tissue.

USU's interest in scrapie dates from the early 1970s when animal scientist Warren Foote was interested in using sheep from the Middle East as a source of breeding stock. Importation of sheep was blocked by the regulations designed to curb scrapie, and Foote thought embryo transfer techniques might circumvent the disease.

His results were promising, although there were some questions about the ability of the inoculum used in the experiment to induce scrapie. A study by another researcher indicated embryos could spread scrapie, although there were also questions about the techniques used in that study.

Factors Affect Susceptibility

That's where the issue stands today. Uncertainty about the mechanism by which scrapie spreads hampers imports and exports of sheep and germ plasm, in addition to inflicting millions of dollars in losses on producers. Holyoak, in collaboration with researchers in New Zealand and Scotland, hopes to settle the question.

The research will involve scrapie-free Cheviot and Suffolk sheep from New Zealand, scrapie-free sheep raised in a specific-pathogen free facility at USU, and a naturally infected flock of Suffolk sheep from Scotland.

A series of experiments will carefully separate the likelihood of transmitting the disease via embryo transfer from other factors involved in susceptibility to the disease, such as genetics (a genetic factor affects the length of the incubation period), strains of scrapie (there are two strains in the United States), breed (in the United States, the disease is more prevalent in black-face breeds), and other possible sources of infection such as contaminated facilities.

Lambs will be studied for 5 years, long enough for most infected animals to show any outward manifestations of the disease and to be detected at post mortem testing. The brain tissue of all sheep used in the study will be examined, which is currently the only way to accurately diagnose scrapie.

Results will aid efforts to control the disease and determine whether some strains are more likely to cross the species barrier from sheep to cattle, which apparently occurred in Great Britain. **KG**

MORE INFO

Reed Holyoak 797-1885
vetclin@cc.usu.edu

Greenville Field Day

Mulch. Horticulturists Larry Rupp and Roger Kjelgren are identifying more water-efficient landscaping techniques. All the results aren't in yet, but it's apparent that mulching around trees boosts growth. In one experimental plot, trees growing in a mulched area that received virtually no irrigation water grew faster than trees growing in competition with irrigated turf. Also of interest: determining whether small bare root trees might subsequently grow fast enough to catch up to larger, more expensive trees grown in ball and burlap, and how landscape plants might be pruned to improve their ability to survive drought.

Oats. For years, researchers have recommended seeding alfalfa without a companion crop such as oats as a method to boost alfalfa yields. Nonetheless, starting alfalfa with oats as a companion crop is still a relatively popular practice. Agronomist Ralph Whitesides is directly comparing the two practices, something (surprisingly) that hasn't been done over the long term. He seeded alfalfa with a herbicide and with either 25, 50 or 100 lbs. of oats per acre and will compare long-term yields.

Other plots compare the yields of various varieties of forage oats, which provides a forage before seeding alfalfa, thus avoiding a summer fallow period. So far, oat varieties Chrisma and Monida seem to be the top yielders, although the relative feed value of Chrisma was slightly higher.

Alfalfa. Weed specialist Steve Dewey had plots comparing the effectiveness of a pre-emergence herbicide with several post-emergence herbicides, either singly or in combination. The results varied, depending on the type of weeds. The best advice—

select herbicides effective against the prevalent weeds. And if you have a limited amount to allocate to weed control, it's better to invest in weed-control early than to wait.

Melons. The herbicides approved for melons tend to stunt plants, and hand-weeding can require 24 hours per acre. In the search for a less-costly alternative, vegetable specialist Dan Drost is trying cover crops. Perennial ryegrass is short and suppresses weeds but tends to compete with melons, slowing their growth. Hairy vetch, a legume, does a reasonably good job of controlling weeds and provides nitrogen, but also tends to suppress early melon growth. Fall-planted oats may be an alternative, but not in Cache Valley where they fail to overwinter. Planting a cover crop such as wheat, rye or triticale effectively suppresses weeds. (A strip remains unplanted for melons.) When the cover crop reaches knee-high, it is sprayed out with glyphosate. One unusual alternative—growing dyers woad as a cover crop. Dyers woad produces a cyanide compound that may suppress weeds. The compound would supposedly be released when dyers woad was sprayed and used as a mulch. So far, however, the results haven't been promising due to a poor stand of woad. (There was a mixed reaction to the proposition that anyone would actually grow dyers woad.)

Pasture. Renewed interest in irrigated pastures is reflected in the Experiment Station's research plots comparing the production and quality of various forages. Research agronomist Jennifer MacAdam offered some preliminary observations based on 3 years of data: Among the grasses tall fescue and orchardgrass were most productive, particularly in the spring. The productivity of perennial ryegrass and Kentucky bluegrass was lower, but more evenly distributed throughout the growing season. Among the legumes, alfalfa fared the best, but improved birdsfoot trefoil clearly has potential for grazing, and is also nonbloating. Cicer milkvetch requires 2 years to become well-established but it has "staying power" in pasture mixtures. (Cicer milkvetch should be used in a mixture because livestock can become photosensitive if they graze pure pastures.) White clover, the traditional favorite for pastures, adds nitrogen but needs careful management or it can quickly dominate grass mixtures in irrigated pastures.

A recent analysis of last year's data showed some surprising trends, MacAdam says. The seasonal yield of all the legumes mentioned above tended to be similar to tall fescue and orchardgrass. Crude protein was high and acid detergent fiber levels were low from mid to late summer. In contrast, the quality of perennial ryegrass, Kentucky bluegrass and meadow brome was highest in July. **KG**

IPM in the West

Integrated pest management (IPM) is working in the West, according USU entomologist Diane Alston. In Utah, recent IPM efforts include the biological control of dyers woad, public education campaigns, and programs for growers of tree fruit and sweet corn. The publication *Integrated Pest Management in the Western Region*, summarizes IPM research in the region. Copies are available from Alston, Biology Department, USU, Logan, UT 84322-5305; (801) 797-2516; dianea@ext.usu.edu.

Recent Grants and Contracts

John Evans, Plants, Soils & Biometeorology Department, is studying jointed goatgrass competition and integrated management in Western winter wheat with funding from Washington State University.

Deloy Hendricks, Nutrition & Food Sciences Department, studies the physiological effects of chitosan and enriched products on rats fed various levels of lipid and fiber. The research is funded by Enrich International.

Sherman Thomson, Biology Department, studies the biological control of dyers woad with a rust fungus on national forest land. His research is supported by the US Forest Service (USDA).

Roger Kjelgren, Plants, Soils & Biometeorology Department, is developing an education package in landscape water auditing and irrigation scheduling for the Central Utah Water Conservancy District.

Janice Kotuby-Amacher, Soil Testing Laboratory, (Plants, Soils & Biometeorology Department) participates in the Western States agriculture laboratory sample exchange program funded by the University of California-Davis.

Lynn Dudley, Plants, Soils & Biometeorology Department, studies the use of saline water from electrical power for irrigation. **Esmaiel Malek**, Plants, Soils & Biometeorology Department, determines the evapotranspiration of crops when irrigated with saline waste water from power plants. Both studies are funded by Utah Power & Light (Pacificorp).

Donald Snyder, Economics Department, is conducting an impact analylsis of the Uintah Basin Ashley National Forest with funding from the US Forest Service (USDA).

Fred Provenza, Rangeland Resources Department, studies the consumption of tannin-rich forage by ruminants with funding from the Binational (United States-Israel) Agricultural Research and Development Fund.

New Faculty

Guy Denton is assistant professor, Agricultural Systems Technology & Education Department. He earned a PhD from Ohio State Univeristy and has been involved in international programs, including an agricultural research and training project in Uganda.

Jeffery Hall is assistant professor, Animal, Dairy & Veterinary Sciences Department. He earned a PhD in toxicology from the University of Illinois and a DVM from Oklahoma State University.

Deborah Campbell is assistant professor, Nutrition & Food Sciences Department. She earned her PhD at the University of Minnesota, where she also conducted postdoctoral research in epidemiology and nutrition.

Awards

Lyle McNeal, Animal, Dairy & Veterinary Sciences, received the Conservation Breeder of the Year Award from the American Livestock Breeds Conservancy and the Distinguished Teacher of the Year Award from the American Society of Animal Science.

PROGRESS TOWARD BETTER RANGELAND ALFALFA

Researchers think they can breed a better drought- and grazing-tolerant variety of alfalfa for rangelands.

Kay Asay, research geneticist with the USDA-Agricultural Research Service Forage and Range Research Laboratory, says there appears to be enough genetic variation to breed an improved variety, based on the performance of accessions from around the world grown at the Blue Creek Dryland Farm, and the results of grazing trials involving 9,000 alfalfa plants underway at Cheyenne, Wyo.

Kay Asay

The ability of an alfalfa plant to vegetatively spread by roots or rhizomes is a key factor in maintaining longevity under dryland conditions, aiding survival if the plant's main crown is damaged." It takes about 2 years for alfalfa plants to demonstrate their ability to spread under rangeland conditions," Asay says. A deep crown also contributes to longevity under grazing. Other promising candidates persist by producing abundant seed.

Asay says selections will be made next year, a prelude to cloning, crossing and additional testing, a process likely to require 4 or 5 years.

Interseeding high-quality alfalfa on rangelands would complement the nutritional value of grasses. Moreover, the nitrogen fixed by alfalfa would aid grass growth. Most alfalfa varieties now available are developed for irrigated or more humid areas and do not persist on rangelands. **KG**

More info

Kay Asay (801) 797-3069
khasay@cc.usu.edu

EXPERIMENT STATION ANNOUNCES ADMINISTRATIVE CHANGES

H. Grant Vest, associate director of the Utah Agricultural Experiment Station, has been appointed to the board of the Leadership Development Program for the Experiment Station Committee on Organization and Policy (ESCOP) and the Academic Committee on Organization and Policy (ACOP). H. Paul Rasmussen, director of UAES, currently serves as national chair of ESCOP.

Vest was also named chairman of the Finance Committee and Rasmussen was named chair of the Endowment Fund Committee of the American Society for Horticultural Science.

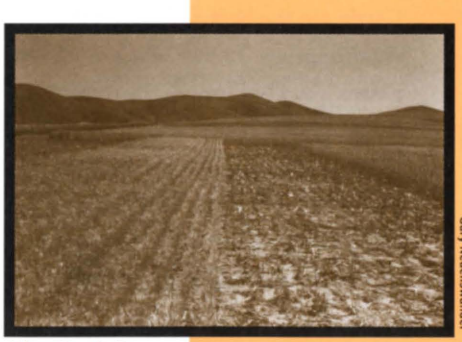
Deevon Bailey, Economics Department, and William Scouten, director of the USU Biotechnology Center, recently completed ESCOP's leadership program. The three-phase course encompasses training, projects concerning the local Experiment Station, and experience with the national policy planning process.

Two faculty members from the Experiment Station participate in the leadership course every other year. Participants are selected from nominations by department heads.

Don Snyder has been named assistant director (25% basis) of the Experiment Station and assistant dean for academic programs of the College of Agriculture (25% basis). His duties as assistant director include an evaluation of the economic benefits of Experiment Station research projects.

The UAES formed an advisory committee for the Blue Creek Dryland Farm. Its members are Deloris Stokes, Darvel Garn, Syd Fuhriman, Scott Fuhriman, and Randy Glover. Richard Wilson of the Utah Department of Agriculture and grower Ross Rudd have also been invited to serve on the committee, which will identify research needs, promote the dissemination of research results, and review current research at the facility.

The Blue Creek Dryland Farm was established from land purchased from funds raised by local farmers. Some members of the advisory committee were involved in raising funds to purchase the farm.



Gary Neuenswander

Blue Creek Farm

Livestock Droppings Aid Rangeland Biodiversity

Some see just a cow pat. Others view it as evidence of a mobile range revegetation system.

Seeds in the droppings of domestic livestock are used to revegetate rangelands in many regions of the world, and they can serve the same purpose in the Intermountain West, according to USU range scientist Chris Call.

"We usually worry about domestic livestock spreading weeds, but there's no reason they can't spread seeds of desirable plants," Call says. Revegetation through livestock droppings is a "less intrusive method of revegetation" than chemical and mechanical treatments, establishing small "satellite" areas that increase rangeland biodiversity.

The method is widely studied on rangelands in Australia. Here, however, critics of grazing often view cattle as sources of damage, not as depositors of desirable grasses and forbs.

Call's research focuses on the spread of cool-season perennial grasses.

Moderate Chewing Leaves Seeds Intact

Cattle are the best domestic livestock for revegetation via droppings. They chew a moderate amount and food passes quickly through the digestive tract, leaving many seeds intact. "Nearly everything passes through in 24 to 48 hours," Call says. In one study, nearly 20 percent of the seeds of Hycrest, a variety of crested wheatgrass, passed through the digestive system intact, of which nearly half germinated.

The "system" can be managed to enhance germination rates.

"If a seed is sensitive to conditions in the digestive tract, increasing the quality of the diet might increase the rate of passage, and improve germination. On the other hand, feeding a lower quality diet could slow the rate of passage and weaken tough seed coats to improve germination," Call says.

Bison droppings are similar to those of cattle, and the tactic might help the bison herd on Antelope Island improve rangelands.

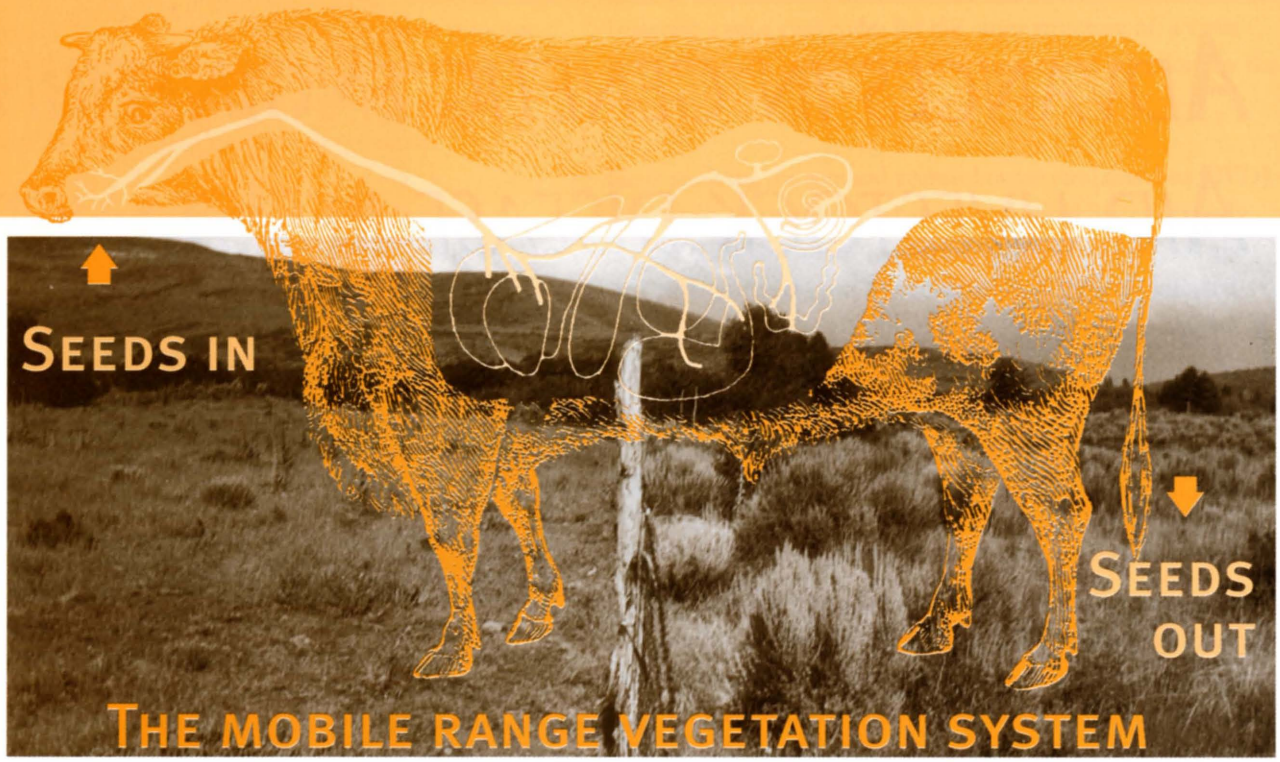
Droppings Favor Germination

Once through the digestive system, the "microenvironment" of dung offers favorable conditions for seed germination, according to Call, who has studied the changes in moisture content, temperature and nutrients in cow pats.

"Cattle dung is a more favorable environment for seed germination, and allows germination over a longer period of time than does soil," Call says. Although crusts form on pats, they usually don't significantly impede the emergence of seedlings.

The attrition of seedlings is high, but those that do survive tend to persist and set seed. "Seventy seedlings might emerge over a 6-week period, but only three or five plants survive on the periphery of the dung. Those that do survive are usually larger and more productive than those drilled in soil."

The "suppressive ability" of cow dung is also an attribute. Although it can smother cheatgrass long enough for crested wheatgrass seeds to germinate, cheatgrass roots subsequently extracted most of the



moisture under the pat. However, cow pats suppressed squirreltail, a perennial plant often found on degraded rangelands, thus aiding the establishment of crested wheatgrass.

Another question is the number and types of seeds to provide per feeding.

About 60,000 Hycrest seeds seems to be about right for cattle, which isn't a huge amount since there are about 200,000 seeds per pound. Common yarrow, a forb, contains almost 3 million seeds per pound. Bitterbrush seeds contained a secondary compound that upset cows' digestive systems.

Introduce Forbs and Shrubs

"In the longer term, this method can change the composition of rangelands, perhaps by introducing forbs and shrubs in areas dominated by grasses," Call says. The revegetation method is likely to be particularly useful in pastoral economies. Most of Call's studies have involved a few animals, but he plans to work on pasture-scale studies.

Although sheep can utilize (and revegetate) rough terrain, their chewing tends to harm larger grass seeds. Moreover, their droppings dry out too quickly and aren't large enough to suppress competing vegetation. They can successfully disperse annual legumes, whose hard seed coats can survive chewing and digestion, and are often used for this purpose in the Middle East.

Horses also tend to chew food too thoroughly, thereby reducing the viability of seeds of cool-season perennials. Still, it might be possible to establish feeding stations so feral horses can ingest and disperse other types of seed.

His research is supported by Mineral Lease Funds and the Utah Agricultural Experiment Station. **KG**

MORE INFO

Chris Call (801) 797-3796
cacall@cc.usu.edu

Seeking Plants with an Affinity for Metal

Gary Neuenswander

Paul Grossl

USU researchers are studying metal-extracting plants that might be suitable for "mining" metals from low grade waste ores, as well as reclaiming metal-contaminated sites.

Several types of plants accumulate relatively large amounts of harmful metals, such as nickel, copper, and cobalt. However, most of these "hyperaccumulators" have been identified abroad, and wouldn't fare well under Utah conditions. Soil chemist Paul Grossl is studying plants better suited to the state's climate, including plants native to the region.

One is *Strepthanthus plygaloides*, one of the few metal hyperaccumulators found in North America. On soils in California containing high levels of trace minerals such as iron and zinc, *Strepthanthus*, a member of the mustard family, can extract 100 times more nickel than normal. The high levels of nickel apparently confer protection against pathogens.

Treatments to Increase Absorption

Researchers with the U.S. Bureau of Mines found *Strepthanthus* could accumulate about 50-100 pounds of nickel per acre. In laboratory studies, Grossl increased absorption to the equivalent of more than 200 pounds per acre, which would make it more feasible to harvest and burn plants to reclaim nickel.

Achieving this level of accumulation may require modification of the rhizosphere via fertilizers and adjustments to soil pH. The calcareous soils that predominate in the western U.S. are alkaline, which lowers solubility (and potential absorption) of metals.

"Green remediation"–harvesting plants on metal-contaminated sites until enough harmful metals are removed to meet regulatory standards–usually requires intensive management that would not be feasible on remote abandoned mines.

"I think these plants might be most useful in extracting metals from low-grade waste ore. They might be useful in bioremediation with irrigation, soil amendments, and fencing to prevent grazing," Grossl says.

Other Promising Species

Grossl, Michael Amacher, soil chemist with the USDA Forestry Sciences Laboratory, and Joan McLean, chemist with the Utah Water Research Laboratory, also scoured abandoned mine sites in Utah and Nevada looking for similar hyperaccumulating plant species. They found two promising tree species that accumulated relatively high levels of lead.

Grossl is studying the apparent ability of the roots of these plants to release chemicals that immobilize metals and prevent their movement through water.

The researchers are also searching for native plants that accumulate lead, chromium, uranium, and arsenic.

It's likely to be several years before these plants are ready for field trials, and even longer before they are ready for commercial use, Grossl says. However, they could be an extremely useful and unusual cash crop for the future. **KG**

MORE INFO

Paul Grossl 797-0411
grossl@cc.usu.edu

Spicing Up Diets Can Spruce Up Livestock Appetites

Imagine your favorite food. Now imagine eating it for months on end.

Welcome to the livestock cafeteria, where the menu seldom changes. The meal may be nutritious, but the limited variety may be enough to make livestock blanch, according to a USU researcher.

Despite the best of intentions, modern agriculture has developed horribly monotonous meals for livestock, which puts a damper on appetite—and on production.

"It's not much different than eating hamburger. None of us would want to eat hamburgers every day, but we don't object when it appears in different forms, such as spaghetti sauce, meatloaf, and tacos," says range scientist Fred Provenza, who is finding that variety in meals is as important to livestock as it is to humans.

It's not just taste buds either. Eating is under the control of a highly complex neurochemical system that scientists are just starting to decipher. There's a lot at stake for livestock producers, who may be disgorging tons of food resembling scrambled eggs when they should be mixing up the fare a little.

Findings Easy to Apply

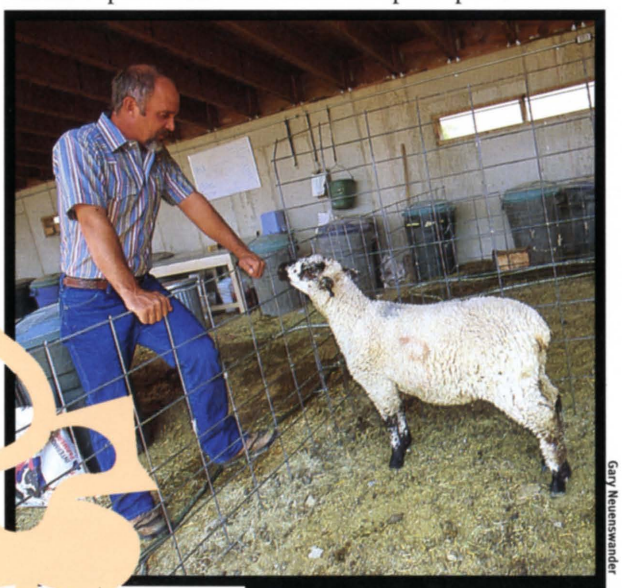
The science may be intricate, but the results may be easy to apply. In confinement operations, routinely changing the flavor of rations and offering foods in a variety of flavors and nutrients might spark appetites, as well as letting each animal eat according to its own nutritional needs, Provenza says.

Variety can make a substantial difference. Consider experiments in which lambs were offered either a variety of foods or a single food at a time. When allowed to chose their foods, lambs increased their intake of digestible energy and protein by a whopping 25 percent.

In many commercial livestock operations, an increase in intake of a few percentage points is viewed as a substantial gain.

Moreover, lambs fed a variety of foods were seemingly able to "balance" their diets to ingest an optimum ratio of energy and protein.

Provenza has studied sheep and lambs, and has begun similar experiments with cattle. The principles should



Gary Neuenswander

Fred Provenza discusses hamburgers with an assistant.

apply to all ruminants, whose digestive systems resemble a fermentation vat that releases chemicals that influence when and what an animal eats.

The preference for variety seems to be mediated by the brain as is evident in studies involving other species.

In rats, for example, a lack of energy triggers the release of norepinephrine, which increases the desire for carbohydrates. And rats that eat high-carbohydrate foods release serotonin, increasing the preference for protein-rich foods. A similar phenomenon seems to affect lambs.

Physiological Limits to Intake

"If livestock are offered only one ration, then they're stuck with a certain ratio of protein to energy. This may limit intake because on the tissue level, each cell needs a certain amount of energy and protein.

"Nutritionists formulate rations for a hypothetical animal. However, each animal differs in physiology and morphology. What's right for one animal may not be right for another. If animals are allowed a choice, they seem to have the ability to choose the right diet, at least as far as energy and protein are concerned, which are the major components of a diet, whether for humans or livestock," Provenza says.

Provenza discovered "remarkable differences" in preferences. In one experiment, 24 lambs could select among the same foods. Twelve lambs preferred the best quality food and 12 preferred the poorest quality food. All reached the same "balance" of protein and energy, however.

Variety could also be important on rangelands and pastures. For example, seeding mixtures of plants instead of monocultures could boost intake.

Provenza studies how chemicals released during digestion interact with the brain to control intake. His research concerning the influence of variety is part of a 5-year study funded by the Cooperative State Research Service (USDA) and the Utah Agricultural Experiment Station. **KG**

MORE INFO

Fred Provenza 797-1604
stan@cc.usu.edu

Student Spotlight

Kalyan Chakraborty is studying one of the most important issues facing society—efficiency in education. It may seem like unusual turf for an economist but his results are proving useful information for educators, parents, and legislators.

Chakraborty works with USU economist W. Cris Lewis. One study now underway compares "inputs" (staff quality, expenditures per student, and the student-teacher ratio) to "output" (standardized test scores), after adjusting for factors such as socioeconomic status that are beyond control of a school district.

His study is the first to use a certain type of economic model (a stochastic frontier production function) in a study of educational efficiency in Utah.

Another study by Lewis and Chakraborty showed that bigger school districts in Utah weren't necessarily more efficient. Generally, consolidation of districts will not result in savings unless it also is accompanied by consolidation of schools.

Chakraborty's other research concerns the value of various recreational activities.

USU's reputation in resource and regional economics attracted Chakraborty after he earned his MS. in Agricultural Economics from the University of Nevada-Reno. Lewis calls Chakraborty the "best graduate student at USU." In addition to his prolific research, Chakraborty has been on the honors list of the Dean of Graduate Studies and the School of Business at USU since his arrival, and was listed in the National Dean's list for 1996 published by Educational Communications, Inc.

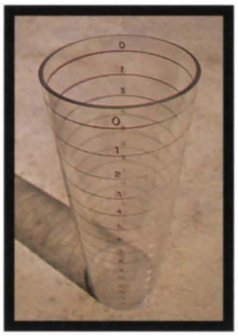
When he completes his PhD, Chakraborty hopes to find employment that offers research and teaching, a combination that is the hallmark of USU and other land-grant universities.

Chakraborty sees his wife, Yan, who is an environmental chemist in Reno, twice a month. Deregulation of the airline industry, another change prompted by economic analyses, makes such a "commute" affordable.

Gary Neuenswander

Kalyan Chakraborty

Answer to last issue's photoquiz: An evaporation refill container used to measure evaporation losses.



PHOTOQUIZ

Clue: Used to modify lab equipment. Answer in next issue.

Gary Neuenswander

Editor's Note

If aversive conditioning really worked, scientists would be cowering in their offices.

At every step, from the search for funding to the publication of results, a scientist's ideas are under attack. An error in a simple procedure can ruin the most elegant experiment. Peers search for flaws in logic or procedure. Editors snip at their prose. Academic disagreements can get nasty.

The odds favor failure.

And there's more pressure for "results," even though knowledge usually increases in small increments, like the slow accretion of geological strata.

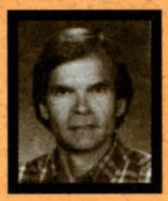
As an editor, I am a bit player in this process. I pick at prose. Sometimes I make egregious errors. And sometimes I fear retribution, what with bruised egos and short fuses. (I was kicked by one irate author, but that was years ago. All is forgiven.)

Yes, we are churning through the information age and there is much harrumping about the process itself. But progress occurs thought by thought, word by word, experiment by experiment. To nurture creativity, we must nurture people. If a system of science does not respect scientists, the process will speak louder than the results.

Kurt Gutknecht (KG)
kurtg@cc.usu.edu

Other Featured Researchers

Charles Carpenter

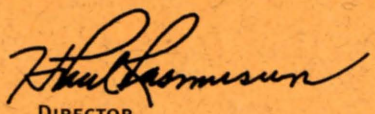


Chris Call

Printed on recycled paper

Utah State
UNIVERSITY

Utah Agricultural Experiment Station
Logan, UT 84322-4845



Director

Nonprofit Org.
U.S. Postage
PAID
Permit 1
Logan, Utah